FOREST PEST MANAGEMENT

United States
Department of
Agriculture

Forest
Service

Northern
Region

State &
Private
Forestry

Report No. 86-13

August 1986

PROGRESS REPORT

A PILOT PROJECT TO EVALUATE EFFICACY OF AERIALLY APPLIED NUCLEOPOLYHEDROSIS VIRUS ON DOUGLAS-FIR TUSSOCK MOTH IN NORTHERN IDAHO

1985

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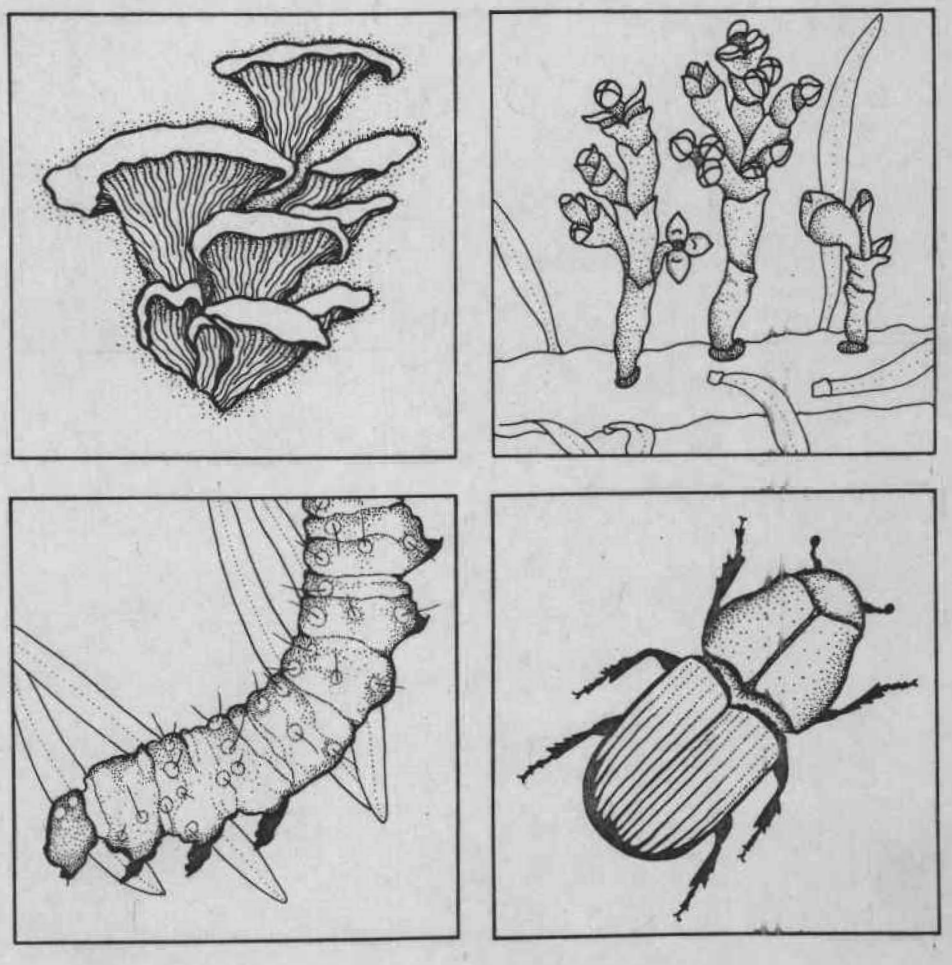

P R O G R E S S R E P O R T

A PILOT PROJECT TO EVALUATE EFFICACY OF AERIALLY APPLIED NUCLEOPOLYHEDROSIS VIRUS ON DOUGLAS-FIR TUSSOCK MOTH IN NORTHERN IDAHO

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by

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INTRODUCTION

The Douglas-fir tussock moth, Orgyia pseudotsugata McD., (DFTM) has reached epidemic levels several times in northern Idaho. The most recent outbreaks began in 1947, 1955, 1963, and 1972 and each collapsed after 2 to 4 years due primarily to epizootics of a nucleopolyhedrosis virus (NPV) and treatment with DDT. Douglas-fir tussock moth pheromone trap catches near Moscow, Idaho have increased continually from 1981 through 1984. No visible defoliation has occurred, but it was believed this trend would continue through 1985. Dewey et al. 1985, recommended further evaluations for egg and larval populations during 1985. Population and stand conditions were found suitable, and a pilot project was conducted to evaluate a virus application during the early outbreak stage. This report describes the objectives, project location, materials, project design, and sampling procedures. Data summaries of the first year are included. Following data collections in 1986, a final report including complete data analysis, conclusions, and recommendations will be prepared.

OBJECTIVES

The primary objective of the project was to obtain data on the performance of a USDA-produced DFTM nucleopolyhedrosis virus formulation (TM Biocontrol-1) produced in Corvallis, Oregon.

Specific tasks include:

1. Determine the effect of an aerial application of TM Biocontrol-1 when applied during an early stage of a DFTM outbreak.

2. Identify and attempt to resolve any mixing or application problems associated with this tank mix.

3. Evaluate defoliation differences in treated and untreated areas during the year following treatment (1986).

4. Determine if DFTM populations in stands adjacent to the treated blocks are affected during the year following treatment.

5. Provide data which will assist research in their devleopment of DFTM sampling designs.

PROJECT LOCATION

This project was located on State of Idaho and private lands near Potlatch, Idaho (figure 1). The project area extends from Mineral Mountain on the north to Moscow Mountain on the south. This area was involved in most of the past outbreaks and tends to be a hot spot or area where defoliation first appears. Evaluation sites (blocks) were selected in the following areas:

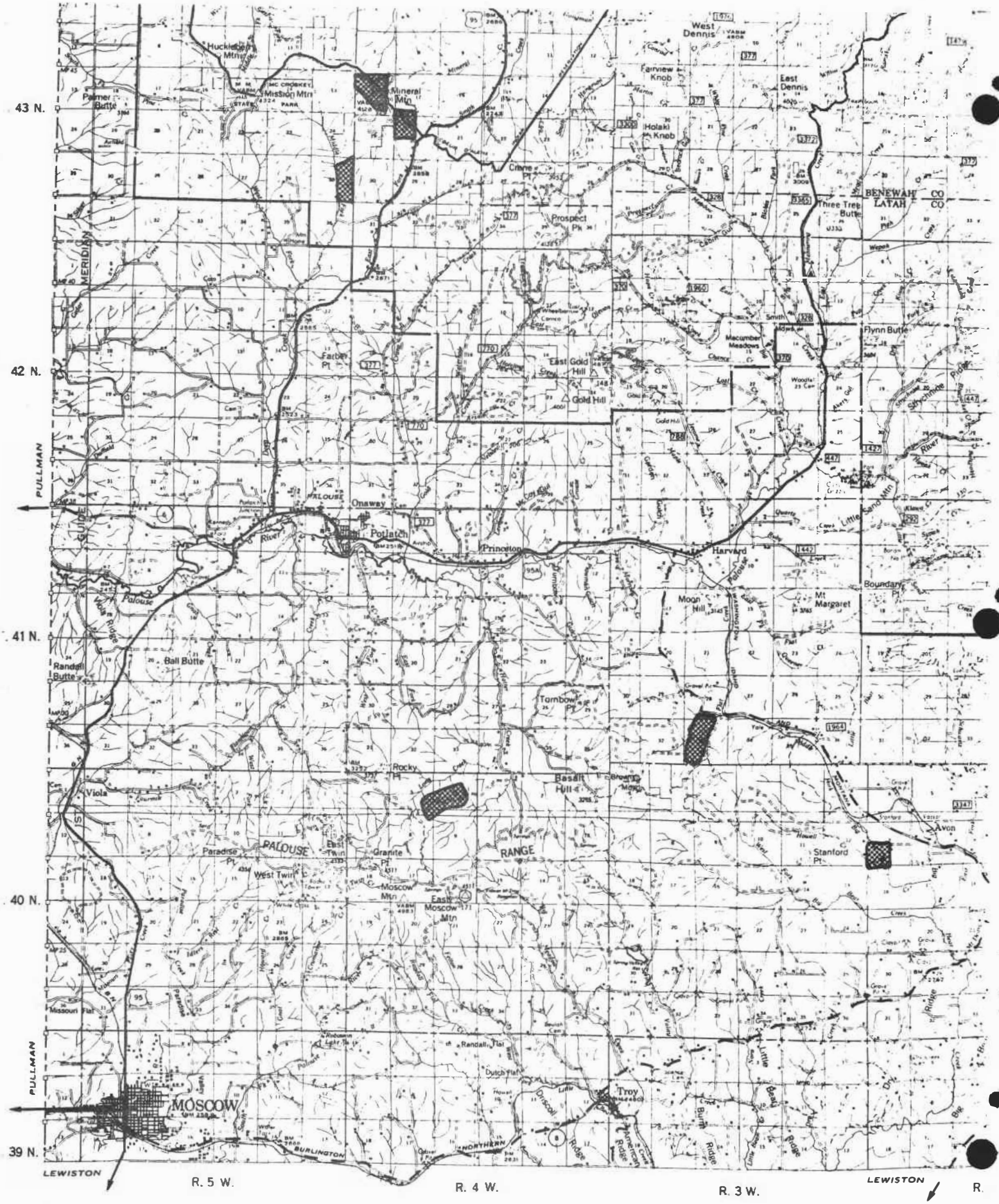

Figure 1. Block locations for DFTM virus project, 1985.

Area	Elevation (feet)
Bear Creek	2750-2850
Deep Creek	2720-3000
Flat Creek	2840-3000
Hatter Creek	3000-3500
Mineral Mountain	3200-3350
Sheep Creek	3700-4100

OVERWINTERING POPULATION ASSESSMENT

As recommended by Dewey et al. (1985), an early spring evaluation was made to determine (1) if the expected population level was suitable for a project and (2) if three or more areas of adequate size (200 to 400 acres) could be identified. Areas with the highest 1984 pheromone trap catches were examined for cocoons. A sampling technique being developed by Dick Mason (personal communication) was used to estimate midcrown larval density based on the proportion of trees having cocoons in the lower crown. Three 45 cm, lower crown branch tips on each of 50 trees per plot were examined for tussock moth cocoons. When egg masses were found, they were collected for rearing to determine virus levels. Soil samples were taken from these sites for virus evaluation.

PROJECT DESIGN

A random block design with three treatment and three untreated control blocks was used. Four cluster sites of 15 sample trees each were selected to represent the block. Trees selected were grand fir or Douglas-fir, approximately 35 to 60 feet tall with full lower crowns. Trees within a cluster were located within a 5-acre area. A soil sample was taken from each cluster site. Treatment blocks were Bear, Deep, and Flat. Control areas were Hatter, Mineral, and Sheep.

FIELD OPERATIONS

Larval Development

Just following egg hatch, another population survey was made to estimate the expected midcrown population at treatment. The lower crown beating technique described in Agriculture Handbook No. 547 (Mason 1979) was followed.

Prespray Larvae

From each of the 60 sample trees per block, three midcrown branch tips were cut to estimate larval density per 1,000 square inches of foliage. See Agriculture Handbook No. 547 for sampling details. This sample was completed within 48 hours prior to treatment.

Postspray 5-Day Sample

Five days following treatment, 25 random larvae were collected from each cluster site. These larvae were placed on prepared diet media for rearing to determine the incidence of virus.

Postspray 17-Day Sample

The same trees and sampling techniques that were used for the prespray sample were used for the postspray sample. All larvae from this sample were also placed on diet media for rearing to determine virus infection.

Soil Sample

Soil samples were collected during both the prespray and postspray larval collections. Samples were taken at the drip line of one tree from each cluster. Washings from these samples were used to inoculate tussock moth diet. Cause of larval mortality at 14 days was diagnosed microscopically. This analysis was done at the Forestry Sciences Laboratory, Corvallis, Oregon.

Postspray Male Moths

Just before adult emergence, five pheromone traps (20 per block) were placed at each cluster site and collected following the flight period (see Agriculture Handbook No. 546; Daterman et al. 1979) to measure the adult male moth population at each plot.

Postspray Egg Masses

An egg mass survey was conducted during late summer. A lower crown examination for 15 minutes by two people was used to estimate egg density.

INSECTICIDE

TM Biocontrol-1 is manufactured by the USDA Forest Service and registered at one-half ounce per acre (1.085×10^9 AU). The active ingredient consists of polyhedral inclusion bodies of the Douglas-fir tussock moth nucleopolyhedrosis virus (figure 2). Polyhedra must be taken into the gut where they dissolve and release virions. Fat bodies ultimately become infected and rupture, thus killing the larvae. This material has no contact action. The DFTM virus is highly infectious to all species of Orgyia. No adverse effects on other organisms have been reported.

APPLICATION TIMING

The general guide for block release was when the most advanced larvae reached the fourth instar and when sufficient new foliage was exposed as a spray target. The specific application was scheduled when 25 percent of the larvae were in the fourth instar.

MIXING AND HANDLING

All pesticide mixing and handling were done by personnel from the Forest Service, Cooperative Forestry and Pest Management and Idaho Department of Lands. Mixing guidelines are found in Technical Bulletin - TM Biocontrol-1 (Appendix). Orzan-LS was substituted for Shade® in the tank mix. Standard safety equipment was used during mixing and aircraft loading. Approved heliport sites were selected near each spray block.

DIRECTIONS FOR USE
GENERAL CLASSIFICATION

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

For population reduction of the Douglas-fir tussock moth, apply by air at the rate of ½ ounce (14.2 grams) TM Biocontrol-1 in 1 to 2 gallons finished spray per acre. Stickers and u.v. protectants may enhance performance of this product. Refer to technical bulletin for mixing and application instructions. Spray tank mixture pH should be 6.0 to 7.2 **NEVER USE CHLORINATED WATER IN THE SPRAY FORMULATION.**

PRECAUTIONARY STATEMENTS
CAUTION
ENVIRONMENTAL HAZARDS

Avoid application to lakes, streams, or ponds. Do not contaminate water by cleaning of equipment or disposal of wastes.

STORAGE AND DISPOSAL

Activity may be impaired by storage above 80°F.

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

Pesticide, spray mixture, or rinsate that cannot be used should be disposed of in a landfill approved for pesticides or buried in a safe place away from water.

Container disposal: Triple rinse and dispose of in an approved landfill or bury in a safe place.

Consult Federal, State, or local disposal authorities for approved alternative procedures.

TM BIOCONTROL-1
BIOLOGICAL INSECTICIDE
FOR THE
DOUGLAS-FIR TUSSOCK MOTH

Active Ingredient:*	
Polyhedral inclusion bodies of Douglas-fir tussock moth nucleopolyhedrosis virus)	3.5%
Inert ingredients:	96.5%
TOTAL	100.0%

*Contains at least 70 million activity units per gram.

KEEP OUT OF THE REACH OF CHILDREN
CAUTION
See back of tag for additional precautionary statements.

For use by or under the supervision of the U.S. Forest Service.

NOTICE: The U.S. Forest Service makes no warranty, express or implied including the warranties or merchantability and/or fitness for any particular purpose, concerning this material except those which are contained on the U.S. Forest Service's label.

MFG. BY: U.S. Forest Service, USDA
14th and Independence Avenues
Washington, D.C. 20250

EPA REG. NO. 27586-1

NET WEIGHT:_____ **LOT NO.:**_____

Figure 2. Sample label.

APPLICATION

A single aerial application of the virus tank mix was applied by helicopter using full jet type nozzles and was released at approximately 50 feet above tree tops. Aircraft were calibrated to apply 1 gallon tank mix per acre at a drop size of 200 to 300 volume median diameter (VMD). Bear Creek and Flat Creek blocks were treated on June 28, 1985. The Deep Creek area was sprayed on June 29, 1985.

AIR OPERATIONS

Air operations were based from a heliport in or near each spray block. Spraying commenced at daybreak and continued until a complete block was finished. A project officer monitored weather conditions during treatment. Conditions never reached the cut off points of winds over 8 mi/h and temperatures above 68°F.

The spray pilot was taken on an orientation flight and provided aerial photography for each block prior to treatment. Aircraft calibration and characterization were completed prior to spraying at the Kamiah, Idaho, airport. The D max system (Dumbauld and Rafferty 1976) was used to estimate drop VMD.

SPRAY DEPOSIT ASSESSMENT

Spray deposit assessment was evaluated on the amount of spray material deposited on Kromkote cards. Cards were placed around sample trees just before spraying. Twenty cards were placed at each cluster site, four per sample tree (five trees). Cards were placed at the drip line, one at each cardinal direction.

SECOND-YEAR EVALUATION

Posttreatment (1986) surveys are planned to evaluate treatment effects on early larvae, defoliation, virus level in soil, adult moths (pheromone traps), and egg mass densities. These surveys will use the same procedures used during the treatment year. Timing of the early larval sample will coincide with the treatment year prespray sample. These data will be combined with the 1985 results into a final project report.

ADMINISTRATION

This project was a cooperative effort between the Idaho Department of Lands and the USDA Forest Service. This progress report was prepared jointly by these cooperators.

INFORM AND INVOLVE

The I&I functions associated with this project were to insure that key individuals and the general public were informed. Of greatest importance was the environmental safety of the DFTM virus and its role in integrated pest management practices. A news release was prepared for the local media prior to treatment.

RESULTS

Overwintering Population

Lower crown beatings on June 10 and 11, 1985, showed an overall tree infestation rate of 98 percent. Data by block were as follows:

	Block	No. trees examined	No. trees infested	% infested
	Bear	No sample		
Treat	Flat	60	57	95
	Deep	60	60	100
	Hatter	60	60	100
Control	Mineral	60	58	97
	Sheep	No sample		
	Total	240	235	98

Larval Development

Following are the larval distributions by instar for the prespray collection on June 27 and 28, 1985.

	Block	Percent		
		2nd instar	3rd instar	4th instar
	Bear	11	78	11
Treat	Flat	2	60	38
	Deep	7	68	25
	Hatter	3	48	49
Control	Mineral	7	73	20
	Sheep	0	86	14
	Mean	5.0	68.8	26.2

Prespray Population

Midcrown population densities (larvae per 1,000 square inches of foliage) are summarized below:

	Block	Cluster 1	2	3	4	Mean
	Bear	0.38	6.06	3.45	4.02	3.48
Treat	Deep	5.92	6.55	4.11	7.34	5.98
	Flat	3.10	7.05	11.63	15.34	9.28
	Hatter	3.15	4.83	3.23	2.40	3.40
Control	Mineral	6.61	2.92	3.76	2.47	3.94
	Sheep	1.79	2.67	1.15	0.81	1.61

Application

Treatment dates were June 28 for Flat and Bear Creek blocks, and June 29 for Deep Creek area. Treatments began each day about 6:30 a.m. and concluded by 9:00 a.m.

Postspray Population 17-Day

Midcrown population densities (larvae per 1,000 square inches of foliage) are summarized below:

	Block	Cluster 1	2	3	4	Mean
	Bear	.52	1.76	1.25	1.64	1.29
Treat	Deep	4.06	3.91	3.59	5.27	4.21
	Flat	4.37	2.91	5.10	9.10	5.37
	Hatter	1.97	2.98	1.73	2.45	2.28
Control	Mineral	1.98	3.49	2.59	1.94	2.50
	Sheep	1.63	1.78	1.60	0.79	1.45

Soil Sample

Percent mortality of larvae infected with soil washing is summarized below:

		Prespray Cause of death		Postspray Cause of death	
	Block	% NPV	% Unknown	% NPV	% Unknown
	Bear	0	24.3	26.8	.8
Treat	Deep	0	24.3	15.8	6.8
	Flat	0	20.0	16.8	7.8
	Hatter	0	25.3	0	6.8
Control	Mineral	0	27.5	0	9.3
	Sheep	0	26.8	0	4.3

Rearing Data

Listed below are the results of the 17-day postspray rearing.

	Block	Number larvae Reared	Number larvae Parasitized	No. adults Male	No. adults Female	Number dead (unknown)	Number dead (virus)	Percent virus
	Bear	34	4	12	0	12	6	17.6
Treat	Deep	116	7	26	18	45	20	17.2
	Flat	165	14	39	12	74	26	15.8
	Hatter	58	2	23	16	17	0	0
Control	Mineral	60	3	24	10	19	4	6.7
	Sheep	39	0	20	6	14	0	0

Pheromone Trap Catch

The following figures represent the average numbers of male moths captured in five pheromone traps located at each of the cluster sites after treatment.

	Block	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Mean
	Bear	6.2	23.6	8.4	71.2	27.4
Treat	Deep	106.6	122.0	93.6	36.4	89.7
	Flat	118.0	109.2	141.0	109.2	119.4
	Hatter	89.0	83.2	102.4	109.6	96.1
Control	Mineral	106.8	92.4	86.0	99.8	96.3
	Sheep	40.8	38.8	22.2	41.2	35.8

Cocoon and Egg Mass Data

Data are expressed in the number of cocoons and egg masses found per minute by a two-person crew during a 15-minute lower crown examination.

	Block	Cocoons/minute	Egg mass/minute
	Bear	.50	.01
Treat	Deep	.75	.05
	Flat	1.33	.08
	Hatter	3.96	.49
Control	Mineral	1.29	.17
	Sheep	.59	.02

Spray Deposit Parameters

Drop diameters were estimated using the D-max system developed by Maksymiuk (1964). Drop density is expressed in droplets per cm^2 and drop diameter in microns.

		Drop density Cluster				
	Block	1	2	3	4	Mean
	Bear	11.39	11.12	10.11	5.90	9.63
Treat	Deep	13.74	20.38	13.04	7.68	13.71
	Flat	14.74	12.72	3.85	13.78	11.27

		Volume median diameter (um) Cluster				
	Block	1	2	3	4	Mean
	Bear	277	238	261	233	252
Treat	Deep	183	189	189	183	186
	Flat	288	255	194	250	246

REFERENCES

Daterman, G. E., R. L. Livingston, J. W. Wenz, and L. L. Sower. 1979. How to use pheromone traps to determine outbreak potential. USDA Agric. Hndbk. 546.

Dewey, J. E., R. L. Livingston, S. Kohler. 1985. Douglas-fir tussock moth population survey, northern Idaho and western Montana - 1983-1984.

Dumbauld, R. K. and J. E. Rafferty. 1976. Field guide for characterizing spray from small aircraft. USDA Forest Service, Missoula, MT. Report TR-76-113 02.

Maksymiuk, Bohdan. 1964. A rapid method for estimating the atomization of oil-based aerial sprays. J. Econ. Entomol., Vol. 57, No. 1.

Mason, Richard R. 1979. How to sample Douglas-fir tussock moth larvae. USDA Agric. Hndbk. 547.

APPENDIX

TECHNICAL BULLETIN

TM BIOCONTROL-1

For use by or under the supervision of the USDA Forest Service

TM Biocontrol-1 consists of polyhedra of the Douglas-fir tussock moth nucleopolyhedrosis virus. Care must be taken in the mixing and application of this product. Stickers and u.v. protectants may enhance performance of this product. The final pH of the spray mixture should be between 6.0 and 7.2. Apply at the rate of 1 to 2 gallons spray mixture per acre.

TM Biocontrol	Amount to result in one-half ounce of TM Biocontrol-1 per acre.
NaOH	Amount sufficient to adjust pH to 6.0 to 7.2.
Molasses	0.25 gallon
Shade^{R}	0.50 pound
Water	0.72 gallon

Small trial sample (100 ml) should be prepared using water from the intended field source to determine the amount of NaOH needed to adjust the pH. NEVER USE CHLORINATED WATER IN THE SPRAY MIXTURE.

Mixing sequence for conventional mixing equipment:

1. Fill tank with water and start agitation.
2. Add NaOH with water and start agitation.
3. Add sunscreen (Shade^{R}) by slowly pouring onto the surface of the water while under agitation. Avoid large lumps of powder.
4. Add molasses by slowly pouring into mixture and mix thoroughly.
5. Check pH.
6. The carrier mixture can be prepared the day before use. TM Biocontrol-1 is added the morning of application and the final formulation mixed for 10-30 minutes.
7. Unused finished spray mixture can be kept 48 hours if the pH is checked to see that it does not exceed 7.5.
8. The mixing equipment should be provided with some type of in-lines filtering device, such that the mixing can be circulated while under agitation. If any foreign materials are in the mixture, the in-line filtering process can be used to remove them. Always use an in-line filter when loading spray mixture.

NOTE: Read label thoroughly before using. Follow all label cautions and directions.